copied from my note-book. It was evidently meant to indicate the continuation of the tail towards the nucleus, as seen on subsequent mornings, when farther from the sun. D is the terminal edge of the tail, as sharp as the outer limb of the moon, and of fullest strength of lustre. Altogether it formed a rather appalling apparition. Clouds soon obscured it. No farther view was obtained for two or three days, when the end of the tail had assumed the usual misty, indefinite outline.

The conclusion forced upon my mind was that the comet, having parted with its tail in its rapid turn at the perihelion, was seen in the act of forcing out a new one ahead of itself, in a solid bank of vapour, the front of which might be compared to the wall of water that heads a freshet in a stream. Another resemblance suggested was that of the solid-looking outline of an up-rolling cumulus cloud.

I will add hereto a statement made to me at the time by the Rev. Hiram Bingham, a distinguished pioneer missionary to the Gilbert Islands. He saw the comet about a week earlier than myself, from Kaneohe, on the east side of Oahu. Both he and his wife observed *waves of prismatic colours running outward* along the brilliant tail. Mr. Bingham is a highly cultivated person, and having commanded the missionary ship for part of two years, is accustomed to lunar and stellar observation. I was led at the time to believe that there was no optical illusion in what he saw.

SERENO E. BISHOP.

Honolulu, June 30.

Copepoda as an Article of Food.

PROF. HERDMAN'S practical demonstration at the North Cape confirms a theory I have long held, that the Copepoda, which abound in every ocean, sea, and lake, might be largely and advantageously made available for human food. It is well known that the species *Calanus finmarchicus*, so abundant in our northern seas, forms the chief food of the Greenland whale. Our own immediate coasts abound in this and other equally edible species. During a recent dredging cruise round the Isle of Man, each pull of the tow-net contained thousands of another and larger species of Copepod, *Anomalocera patersonii;* and Dr. John Murray has found that a still larger species, *Euchæta norvegica*, is plentiful in the lower depths of several Scotch lochs.

A number of finely-meshed trawls, used off the west coast of Ireland, would, I am convinced, furnish excellent food for starving multitudes in time of need.

A propos of the distribution of Copepoda, my attention was called a few days ago by the Mayor of Bootle to the filter-beds of the town salt-water baths, which he said were swarming with Entomostraca. The water is supplied direct from the river, and examination showed the presence of Copepoda in enormous quantities, the bulk of them being *Eurytemora hirundo*, a species only once before taken in Britain, and then in near proximity to Bootle. Probably other filter-beds are equally prolific, and may prove valuable hunting-grounds, the Copepoda undoubtedly acting as scavengers in keeping the water pure from putrefaction.

I. C. THOMPSON.

Liverpool, July 24.

Meteorological Phenomenon.

I HAVE received in a letter from a friend residing in Boraston, Shropshire, the following account of a remarkably interesting meteorological phenomenon, which is well worth putting on record:—

"We had a curious sight from this house yesterday [July 26]. It was a dead calm, but in a field just below the garden, with only one hedge between us and it, the hay was whirled up high into the sky, a column connecting above and below, and in the course of the evening we found great patches of hay raining down all over the surrounding meadows and our garden. It kept falling quite four hours after the affair. There was not a breath of air stirring as far as we could see, except in that one spot."

FRANCIS GALTON.

Refraction through a Prism.

IN such elementary text-books on geometrical optics as I have consulted it has always seemed to me that the writers have found a difficulty in presenting a precise direct proof of the theorem that when a ray is turned out of its course by direct passage through a prism, its deviation is least when its path is symmetrical with regard to the prism.

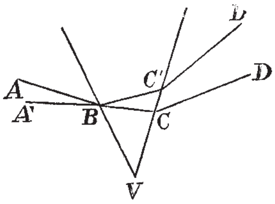
May I ask you to consider the simple proof which I inclose, and may I leave it to your judgment whether it is worth while that it should be presented to the notice of teachers in the pages of NATURE? My knowledge of text-books I cannot suppose to be exhaustive, and the arrangement of the proof which I inclose of course may not be any novelty.

JOHN H. KIRKBY.

Radley College, Abingdon, June 11.

Minimum Deviation.

The problem is to find two rays which, passing directly through a prism near together, have their directions changed by the prism to the same amount—for in the limit, these, when brought into coincidence by change of position of the prism, will mark the course of that ray which suffers minimum deviation (experiment may be appealed to, to show that it is minimum and not maximum). Let ABCD be the course of a ray of light through the prism whose vertex is V. At B make the $\angle VBC' = \angle VCB$, then if the ray BC′ is continued out of the prism on both sides, it is evident that its completion D′C′BA′ meets and leaves the faces of the prism at exactly the same angles as the original ray ABCD, only in the opposite direction. Thus the two rays ABCD, A′BC′D′ suffer equal deviation, and because the Δ's VBC, VC′B are similar,



$$\therefore VB^2 = VC \cdot VC';$$

and when the rays are so close as to practically render C, C′ coincident, we have $VB^2 = VC^2$, or $VB = VC$ when the deviation is a minimum, *i.e.* the deviation is a minimum when the course of the ray makes equal angles with the sides of the prism.

[Oxford men will remember that more than twenty years ago Prof. Clifton gave a somewhat similar proof as follows:—

Since the paths ABCD and D′C′BN are similar, if one is a path of minimum deviation the other must have the same property also. Hence, since light can always travel in the reverse direction along a path, the paths

ABCD and NBC′D′

are both paths of minimum deviation.

But the existence of two such minima is contrary to experiment. Hence the paths must be identical, which can only be the case of the angle $VBC = VBC' = VCB$.—ED.]

Further Notes on the Anatomy of the Heloderma.

SINCE I published in NATURE (vol. xliii. p. 514), "The Poison Apparatus of the Heloderma," there has appeared from the pen of Mr. Boulenger another notable contribution to the anatomy of that genus of reptiles, entitled "Notes on the Osteology of *Heloderma horridum* and *H. suspectum*, with Remarks on the Systematic Position of the *Helodermatidæ* and on the Vertebræ of the Lacertilia," (P.Z.S., January 20, 1891). That paper is especially useful, inasmuch as it critically compares the vertebral columns of the two species of Lizards under consideration—a comparison which, up to the time of the appearance of Mr. Boulenger's paper, had not been made. To briefly recapitulate his points, Boulenger finds differences in the form of the premaxillaries of the two species, and in the number of teeth supported by those bones. He finds palatine and pterygoid teeth constantly absent in *H. suspectum* but present in *H. horridum*—a very remarkable fact. A small azygous ossification was found in the cartilage of the mandibular symphysis of *H. horridum*, "apparently the homologue of the symphysial (mento-meckelian) bones of most tailless Batrachians." This

© 1891 Nature Publishing Group

last discovery has important bearings in other directions. In the vertebral column there appear to be a total of 76 vertebræ in the case of *H. horridum* to but 63 or 65 in the spine of *H. suspectum*. And, in conclusion, this distinguished herpetologist remarks that "A short rib is present on the third cervical in *H. horridum*, which is absent in *H. suspectum;* the neural spines are more elevated in the middle and posterior portion of the dorsal region in *H. horridum*, specimens of the same sex, of course, being compared. The neural spines are much more developed in the male" (p. 116). Boulenger still thinks the place of the *Helodermatidæ* between the *Anguidæ* and the *Varanidæ*, which he assigned to them in 1884.

In concluding this notice I am led to pass some observations upon certain strictures Mr. Boulenger has made in his paper upon my memoir on the anatomy of *H. suspectum* which appeared in the Proc. of the Zool. Soc. of London for 1890. His criticism of my description of the atlas of *H. suspectum* is well taken, as I have satisfied myself of by an examination of better material since. That bone is found to be in *three* pieces, and not in *five* as stated by me. He is also quite correct when he comes to point out certain errors in my figures of *manus* and *pes* of that reptile, and I thank him for having called my attention to them. With respect, however, to the error he believes me to be guilty of in my description of the teeth in the premaxillary bones of *H. suspectum*, I can in no way agree with him. He observes: "Eight or nine præmaxillary teeth are present in *H. horridum*, and only six in *H. suspectum*. Dr. Shufeldt, however, represents eight teeth in the latter species; but his figure, showing all the teeth as of the same size, looks very diagrammatic." In his figures illustrating these remarks Mr. Boulenger gives *H. horridum* but *six* teeth, and *H. suspectum* but *four*, and the drawings of the bones look, indeed, very diagrammatic. I cannot conceive of any lizard normally having but "nine" teeth in its premaxillary bone; it should at least be an even number. Now the mounted specimen of *H. suspectum* in the collections of the U.S. National Museum, has *eight* teeth in its premaxillary, and it was from that specimen that I drew my figure which appeated in the Proceedings. Normally, that is the number, but those teeth are often broken out in the Heloderms, and they become irregular by subsequent growth. The outer ones are always the longer, when the skull is perfect. In so far as the *form* of the premaxillary is concerned, as touched upon by Mr. Boulenger, I believe no little allowance must be made for *individual variation*, which is often quite considerable among lizards as it is among Vertebrates higher in the scale. Other figures illustrating the work under consideration are excellent.

It would appear that it is to be the fate of the *Helodermatoidea* to have their morphology more thoroughly worked out than most, or even any other, lizards up to the present time; and I am given to understand that Prof. Garman, of Harvard College, has it in mind to review, in the near future, the entire structure of *H. suspectum*. R. W. Shufeldt.

Smithsonian Institution, July 8.

THE DISCOVERY OF THE STANDARDS OF 1758.

The discovery by the Clerk of the Journals of the House of Commons, referred to in Nature last week (p. 280), of the original standards of length, which were in 1758 deposited in the custody of the Clerk of the House, has attracted some attention to the history of these Parliamentary standards. As some misapprehension as to the effect of such discovery appears to have arisen, and as it is to eminent men of science that we are mainly indebted for our standards of length, the following explanatory notes may interest many of our readers.

The standards of length above referred to were made under the directions of a Committee of the House of Commons, of which Lord Carysfort was Chairman, appointed on May 26, 1758, "to inquire into the original standards of weights and measures in this kingdom." The Committee reported that in 1742 several members of the Royal Society were at great pains in taking an exact measure of the ancient Exchequer standards of length (of Henry VII. and Queen Elizabeth), then condemned by the Committee as being coarsely made and "bad standards"; that such measure was made by "very curious instruments prepared by the late ingenious Mr. Graham"; and that the Royal Society had lent to the Committee a brass rod made pursuant to these experiments, which rod had been compared by Mr. Harris, of the Royal Mint, with the Exchequer standards. Mr. Harris advised the Committee that the Royal Society's standard was made so accurately, and by persons so skilful and exact, that he did not think it easy to obtain a better standard; and accordingly the Committee then had two rods made by Mr. Bird, an optician, according to Mr. Harris's proposal; which "rods" were laid before the House. The rod marked "Standard Yard, 1758," was to be taken as the proper standard; it was stated by the Committee to be made of brass, to be about 38 or 39 inches in length and about one inch thick; near to each end of the rod a fine point and line being drawn on a gold stud, the distance between the points on the gold studs being the "true standard length of a yard," or 36 inches. The second rod was made in the same manner as the first rod, excepting that it had "two upright cheeks" instead of points or lines; so that any other yard rod might be measured by being placed between the cheeks. Both these rods (together with three standard troy pounds marked "$\overset{\text{lb}}{\underset{1758}{\text{T}}}$," with a crown and "G.2," and a set of troy standards from 2 pounds to 32 pounds, made and adjusted by Mr. Harris "with very curious and exact scales of his at the Mint") were stated by the Committee to be then deposited with the Clerk of the House of Commons.

In 1838 the attention of the Government was directed to the necessity of determining a new standard weight and measure to replace the above standards of 1758, which were stated by the Chancellor of the Exchequer—in a letter to Mr. G. Airy, the Astronomer-Royal—to have been "destroyed by the burning of the Houses of Parliament," and a Commission was appointed to restore the standards. The Commission included F. Baily, J. E. D. Bethune, Davies Gilbert, J. S. Lefevre, J. W. Lubbock, Geo. Peacock, R. Sheepshanks, J. Herschel, and G. B. Airy. Their report of 1841 gives a precise description of the condition of the standards at the Journal Office immediately after the fire. The Committee reported that the legal standard of one yard was "so far injured that it was impossible to ascertain from it with the most moderate accuracy the statutable length of one yard"; and also that the "legal standard of one troy pound was missing." New Parliamentary standards of length and weight were accordingly made under the directions of the Committee, and were legalized by an Act of Parliament passed in 1855. These new Imperial standards are now deposited with the Board of Trade, but legal "Parliamentary copies" of them are stated to have been immured, in 1853, in the House of Commons, and further copies were then deposited at the Royal Mint, the Royal Observatory, and with the Royal Society. These latter Parliamentary copies are legally required to be compared with each other once in every ten years, but those deposited at the House of Commons are excepted from any such comparison. It would appear, however, that the House of Commons standards are sometimes examined, as is shown by some printed correspondence on this subject which was laid before the House of Lords in 1872, in which year the standards were examined, and after their examination were again immured in a wall near the lower waiting hall of the House of Commons; a certificate of the deposit of the standards being given as follows:—

"It is hereby certified that this day, in the presence of the undersigned, the oaken box containing the Parliamentary Copy No. 4 of the Imperial Standard Yard, and the Imperial Copy No. 4 of the Imperial Standard Pound," . . . has been "deposited within the wall on

© 1891 Nature Publishing Group